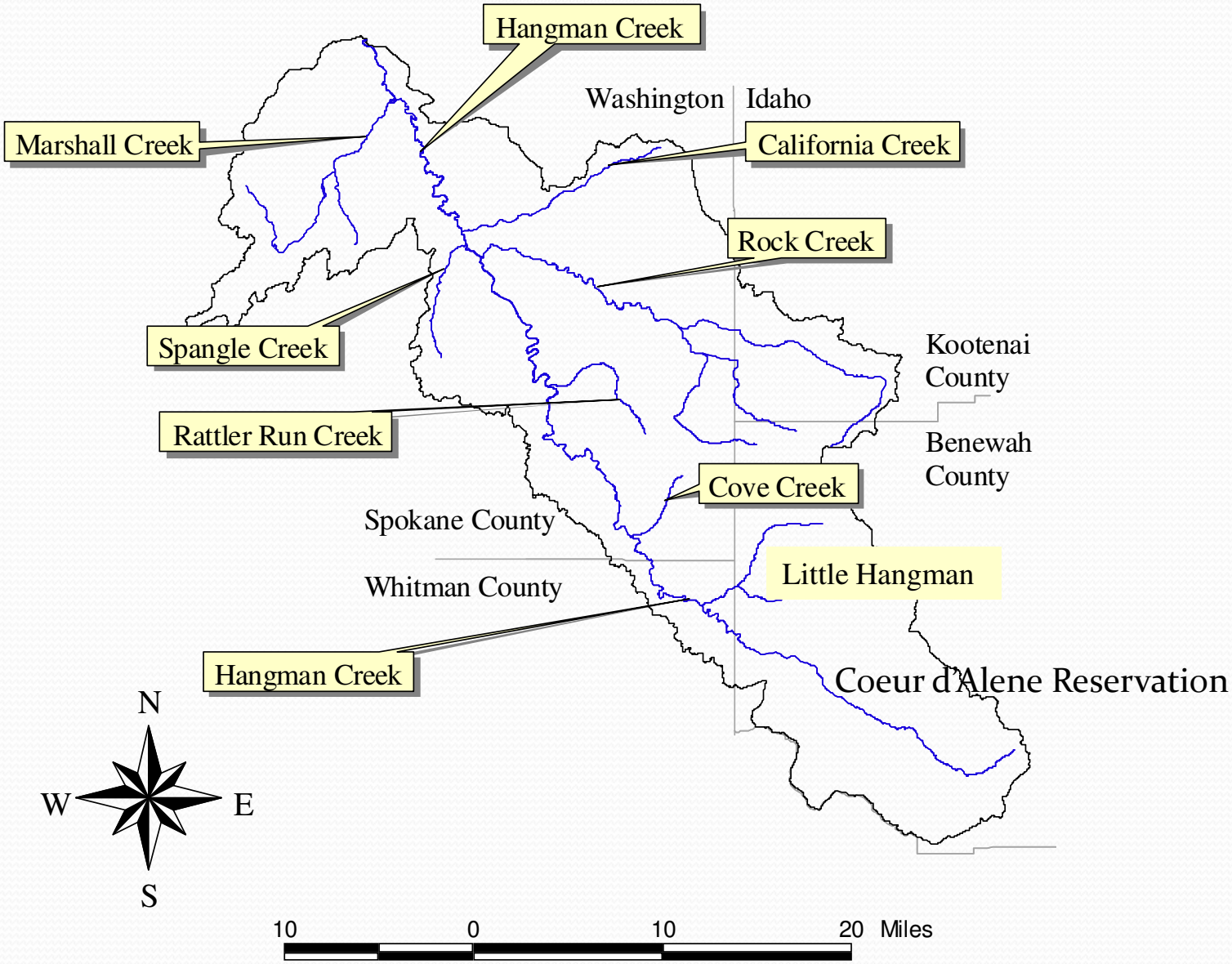
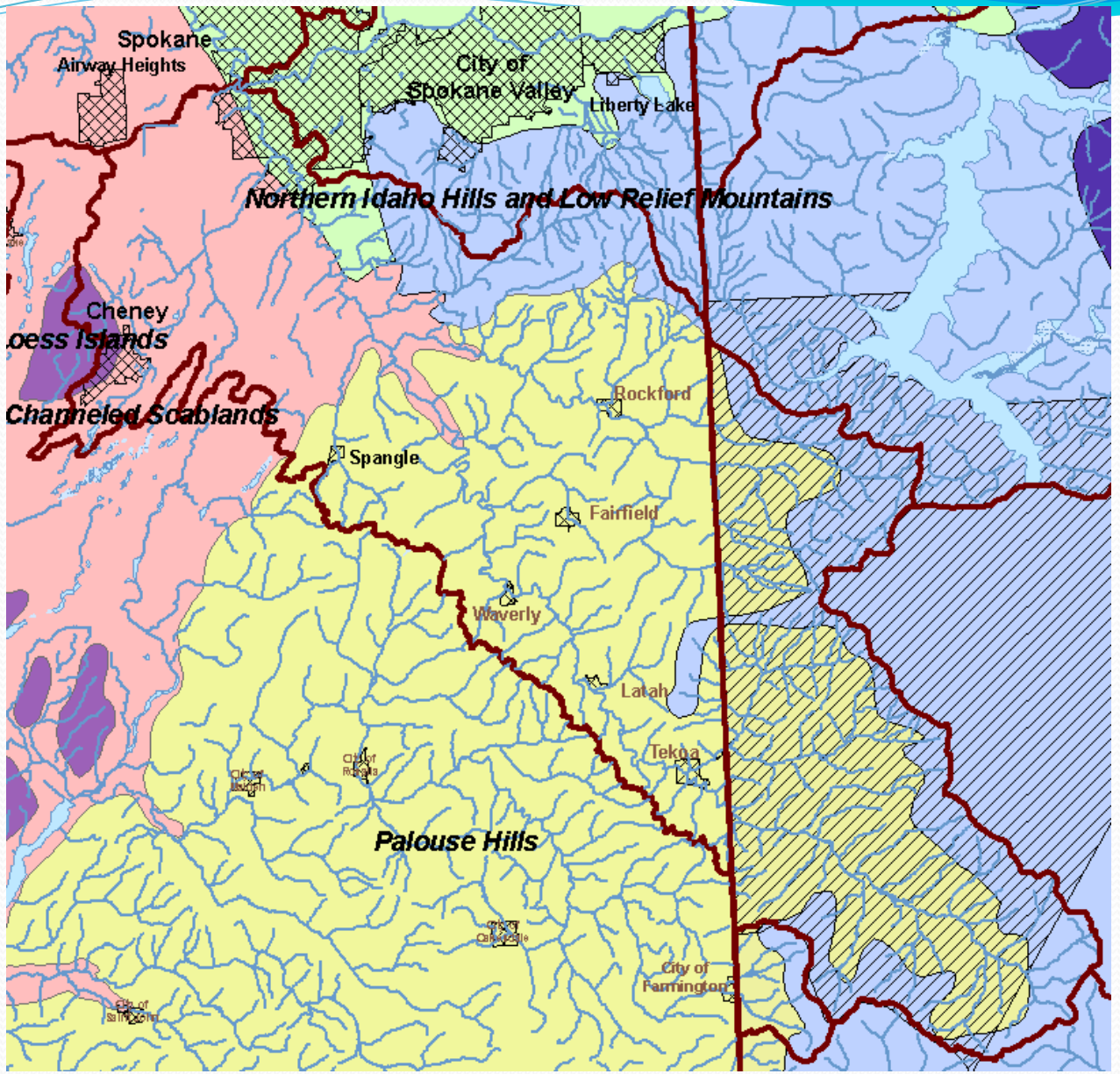
Hangman Creek TMDL

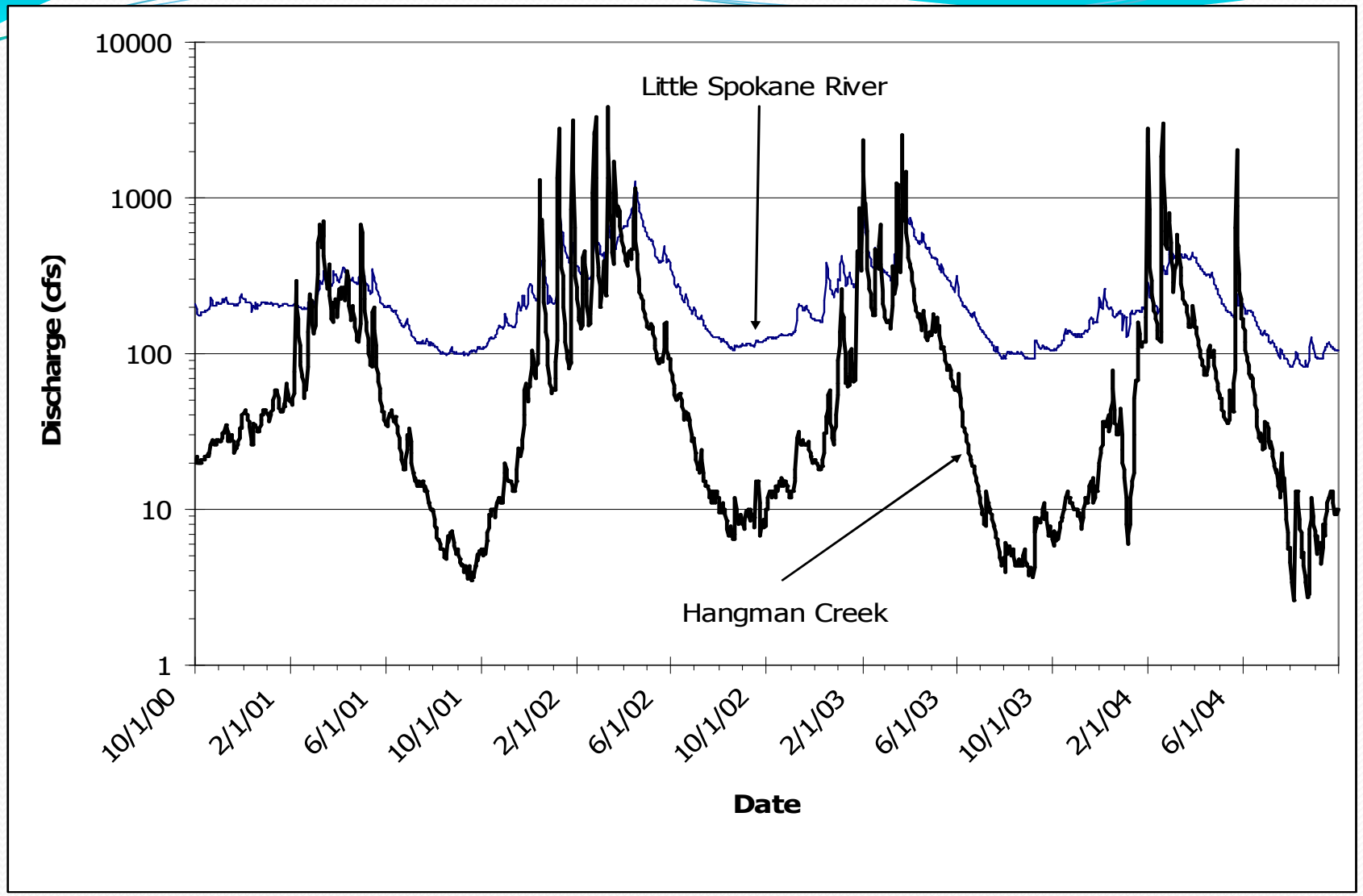
May 15, 2009

Background

- Began Hangman Creek TMDL in 2003
  - Study December 2003-August 2004
  - Advisory group formed April 2004
- Spokane County Conservation District is a partner in the effort (funded by a Centennial Clean Water Fund grant)
- Addresses fecal coliform bacteria, temperature and turbidity/total suspended solids
- Also listed for dissolved oxygen and pH
- Originally included phosphorus to address Spokane allocation at the mouth
  - Did not address dissolved oxygen and pH impairments in Hangman Creek watershed
  - EPA concluded that without addressing in-stream impairments phosphorus allocations could not be considered a TMDL.
- Implementation should also help reduce nutrients


Hangman Creek
Washington
Idaho
Marshall Creek
California Creek
Rock Creek
Spangle Creek
Kootenai County
Rattler Run Creek
Benewah County
Cove Creek
Spokane County
Little Hangman
Whitman County
Hangman Creek
Coeur d'Alene Reservation
N
W
E
S
10
0
10
20 Miles


Spokane
Airway Heights
City of
Spokane Valley
Liberty Lake
Northern Idaho Hills and Low Relief Mountains
Cheney
oess Islands
Channeled Scablands
Rockford
Spangle
Fairfield
Waverly
Latah
Tekoa
Palouse Hills
City of
Farmington


10000
1000
100
10
1
Discharge (cfs)
Little Spokane River
Hangman Creek
10/1/00
2/1/01
6/1/01
10/1/01
2/1/02
6/1/02
10/1/02
2/1/03
6/1/03
10/1/03
2/1/04
6/1/04
Date

Hangman Creek TMDLs

- Reduce **Fecal coliform bacteria** to protect human health
- Lower **Temperature** to protect aquatic life
- Decrease **Suspended Sediment and Turbidity** to protect aquatic life, reduce flooding potential, reduce nutrient and toxics transport, and reduce the need for dredging in the Spokane River

Fecal Coliform Bacteria TMDL

- Bacteria concentrations show a **decreasing trend**, but it may have to do with decreasing streamflows
- **High water and storm events** any time of the year are the usual cause of high bacteria counts
- Most places in the watershed **do not meet** the 'not more than **10%** of samples shall exceed **200** coliform/100 milliliters', **but** none exceed the average

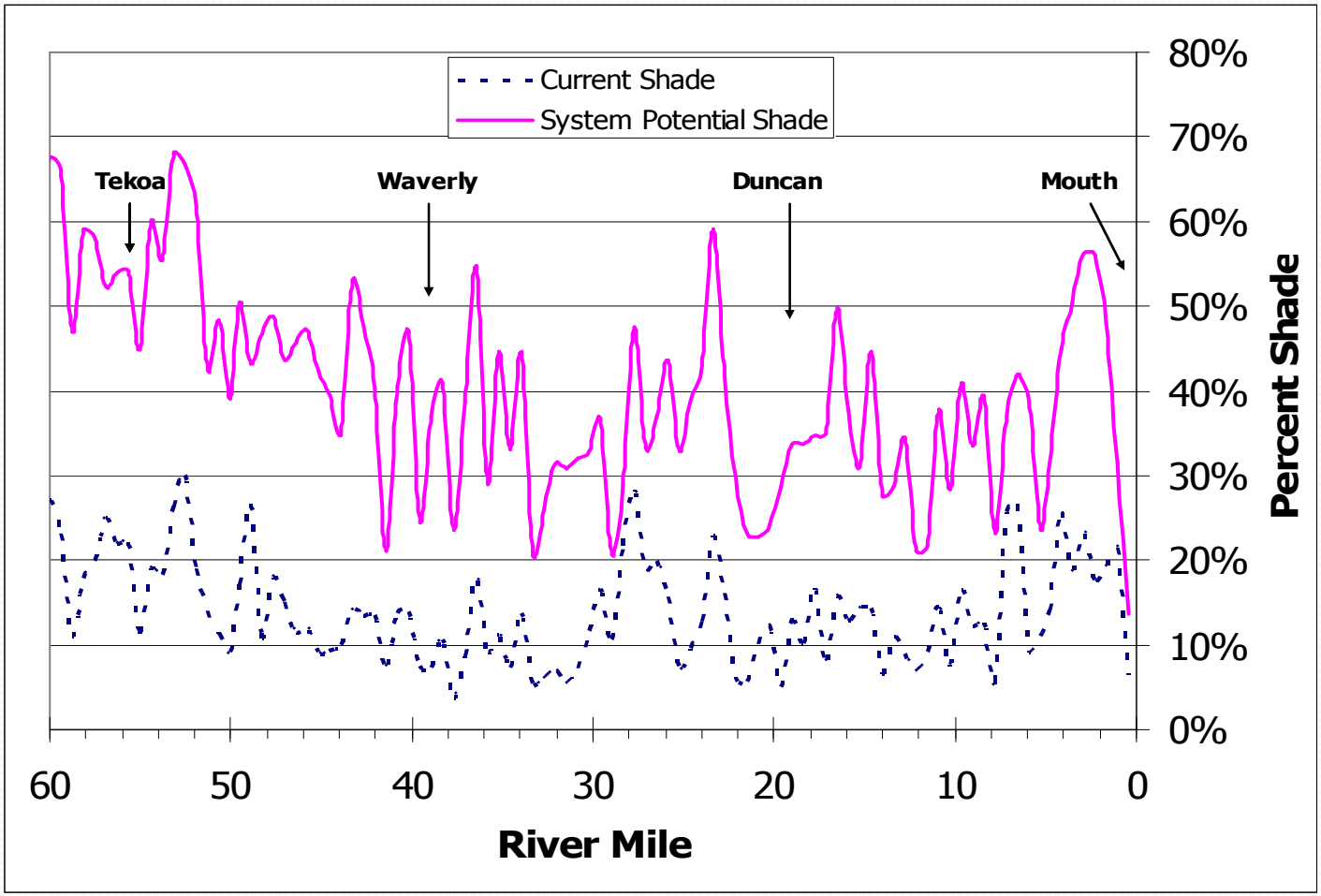
Fecal Coliform Bacteria TMDL

Recommended Reductions

- **50% - 75%**: Hangman, Little Hangman, and Rock Creek
- **80% - 85%**: Cove Creek and Rattler Run – mainly as nonpoint source
- **~50%**: Marshall and California Creek in some reaches, others less

Targets do not replace the standard

Temperature TMDL



Increases of 7% to 43% along the mainstem to meet effective shade requirements

Temperature TMDL

- Tekoa and Spangle WWTPs
  - Maximum temperature effluent limits recommended to prevent addition instream heating - **7DADMs in June, July, and August of 18.2º C, 21.5º C, and 17.7º C**, respectively
  - Temperature monitoring is now required at all WWTPs – any new discharges will need to meet limits
- Stormwater jurisdictions
  - The most critical season (June through August) rarely has storm events of enough intensity and duration to generate significant municipal stormwater that would increase stream temperatures over a 7-day period.
  - Spokane County, the City of Spokane, and WSDOT will ensure stormwater does not heat the creek or tributaries

Turbidity and Suspended Sediment TMDL

- **Effects on aquatic communities**:
  - (1) acting directly on the fish swimming in the water and either killing them or reducing their growth rate, resistance to disease, etc.;
  - (2) preventing the successful development of fish eggs and larvae;
  - (3) modifying behavior, natural movements, and migrations; and
  - (4) reducing the abundance of available food.

Turbidity and Suspended Sediment TMDL

- **Other effects of concern**:
  - Significant correlation of suspended sediment with phosphorus – **phosphorus transport**
  - Some **pesticides, metals, and polynuclear aromatic hydrocarbons** from city and farm sources transported by sediments
  - **Sediments fill** creek **channels** and river **pools**:
    - Flooding hazard
    - Decrease pool capacity for river and dam operations

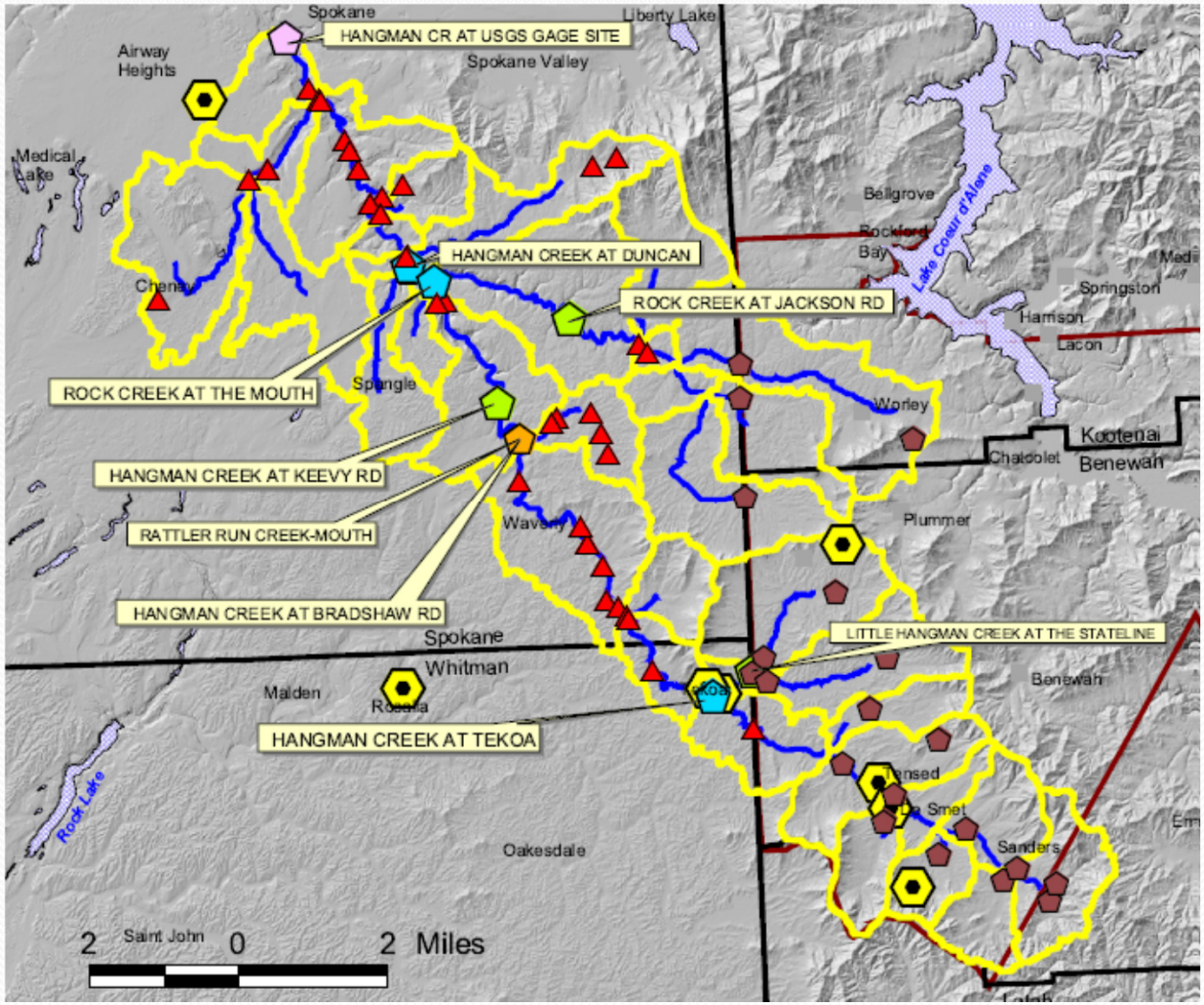
Turbidity and Suspended Sediment TMDL

- Total suspended solids (TSS) concentrations and turbidity show a **decreasing trend** over the past 10 years, but may have to do with decreasing streamflows
  - Recent **efforts to improve** the stream channel, restore riparian areas, and a switch to less erosion-prone farming practices **may also have helped** reduce loads
- **Highest concentrations and loads** occur during **winter and spring** snowmelt and runoff events
- **Naturally eroding (Lake Missoula flood sediment) streambanks** and **highly erodible (Palouse) soils** are present in various parts of the watershed
  - Further destabilized by poor road-building and construction practices, channel modification, and some agricultural practices.

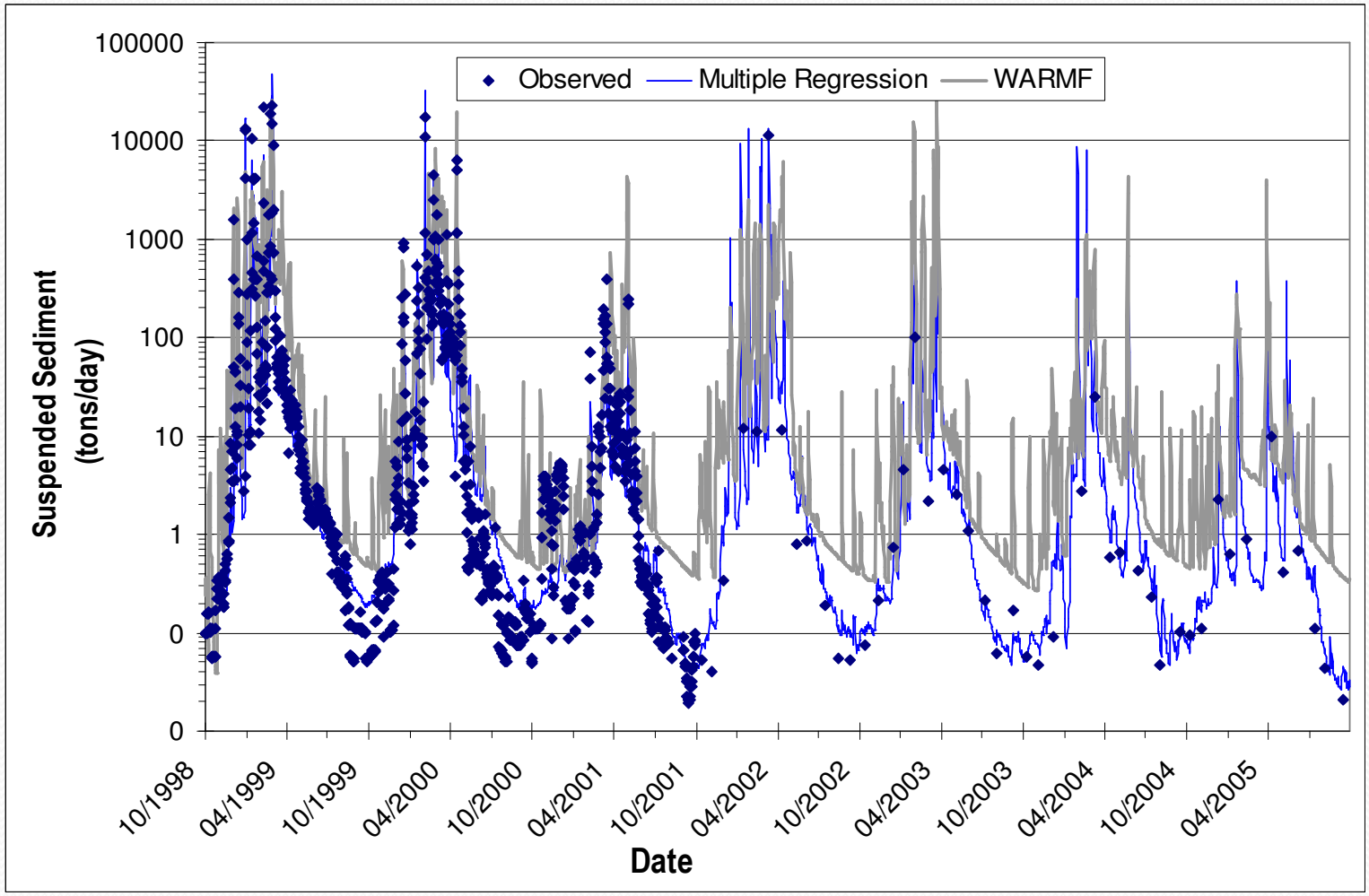
Turbidity and Suspended Sediment TMDL

- **Analytical tools** used to examine the suspended sediment and turbidity data:
  - **Statistical tests** were run to compare sediment and turbidity values.
  - A **multiple regression** analysis method to simulate the suspended sediment loading at the mouth of Hangman Creek over 14 years.
  - A **watershed pollutant delivery model** was developed to see where sediment loads were coming from and how they were transported through the watershed.
  - **Severity scores** calculated to determine level of harm to trout

Turbidity and Suspended Sediment TMDL



Turbidity and Suspended Sediment TMDL



Turbidity and Suspended Sediment TMDL

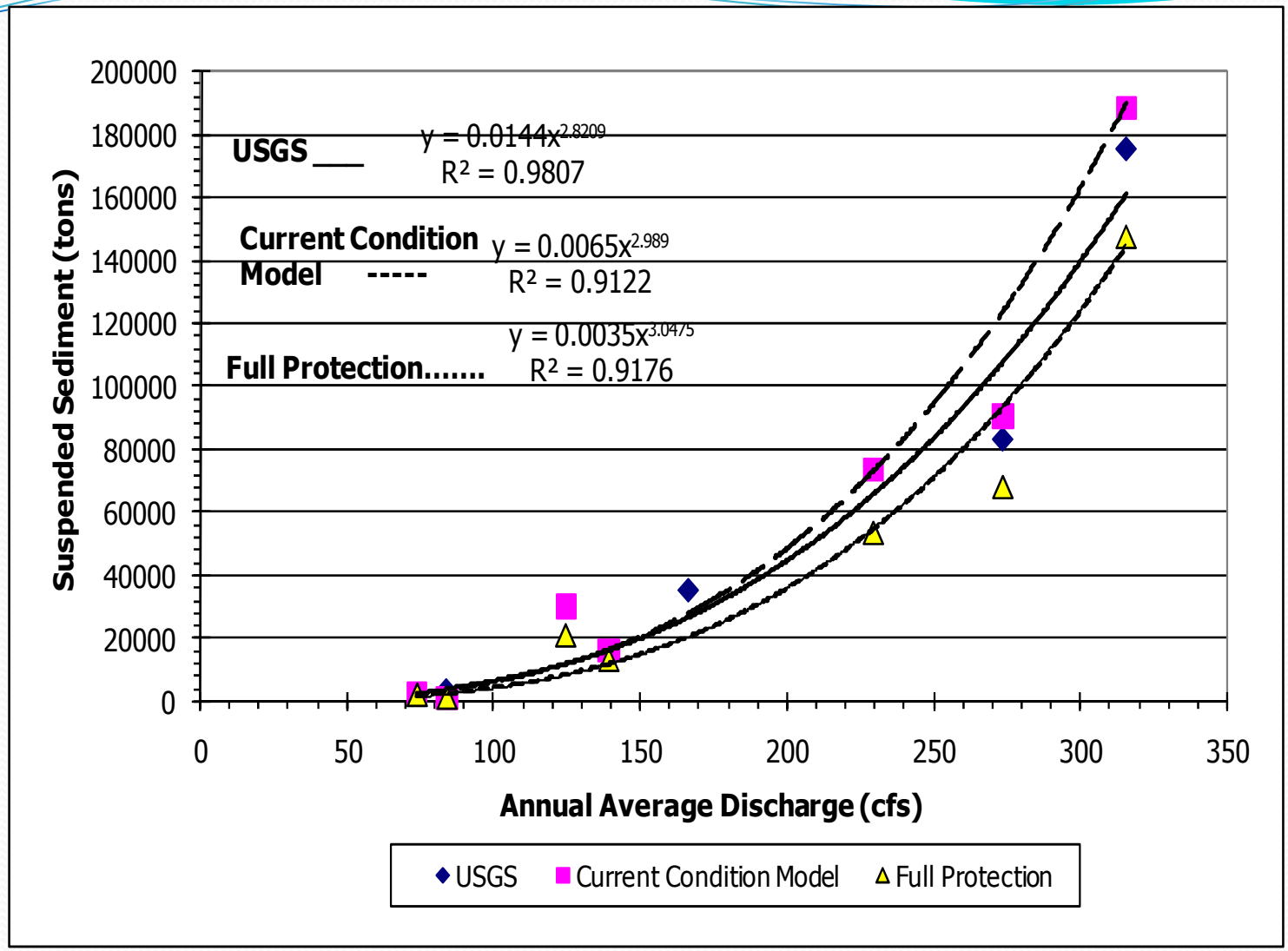
Full protection scenario in WARMF to determine reductions of total suspended solids

- The following actions were identified by the Advisory Committee for the full protection scenario:
  - Convert 60% of the agriculture in the watershed to direct seed or conservation practices.
  - Reduce the streambank erosion in the upper watershed (above Fairfield) by 50%, and high-bank erosion in the lower watershed from Lake Missoula flood sediments by 10%.
  - Increase forest cover in catchments above Rockford and Tensed by 50%.
  - Limit residential growth to levels below 10% in the lower watershed (catchments 3, 4, 7, 9 and 10).
  - Riparian buffers established all along the mainstem channels and tributaries.

Turbidity and Suspended Sediment TMDL

Water Year	Estimated Annual Suspended Load (tons/year)	Estimated Reduction	Estimated Load Capacity (tons/year)
1999	188,252	**22%**	147,206
2000	90,677	**25%**	67,872
2001	1,604	**31%**	1,109
2002	73,770	**28%**	53,326
2003	16,503	**21%**	13,101
2004	30,605	**32%**	20,846
2005	2,832	**29%**	2,022

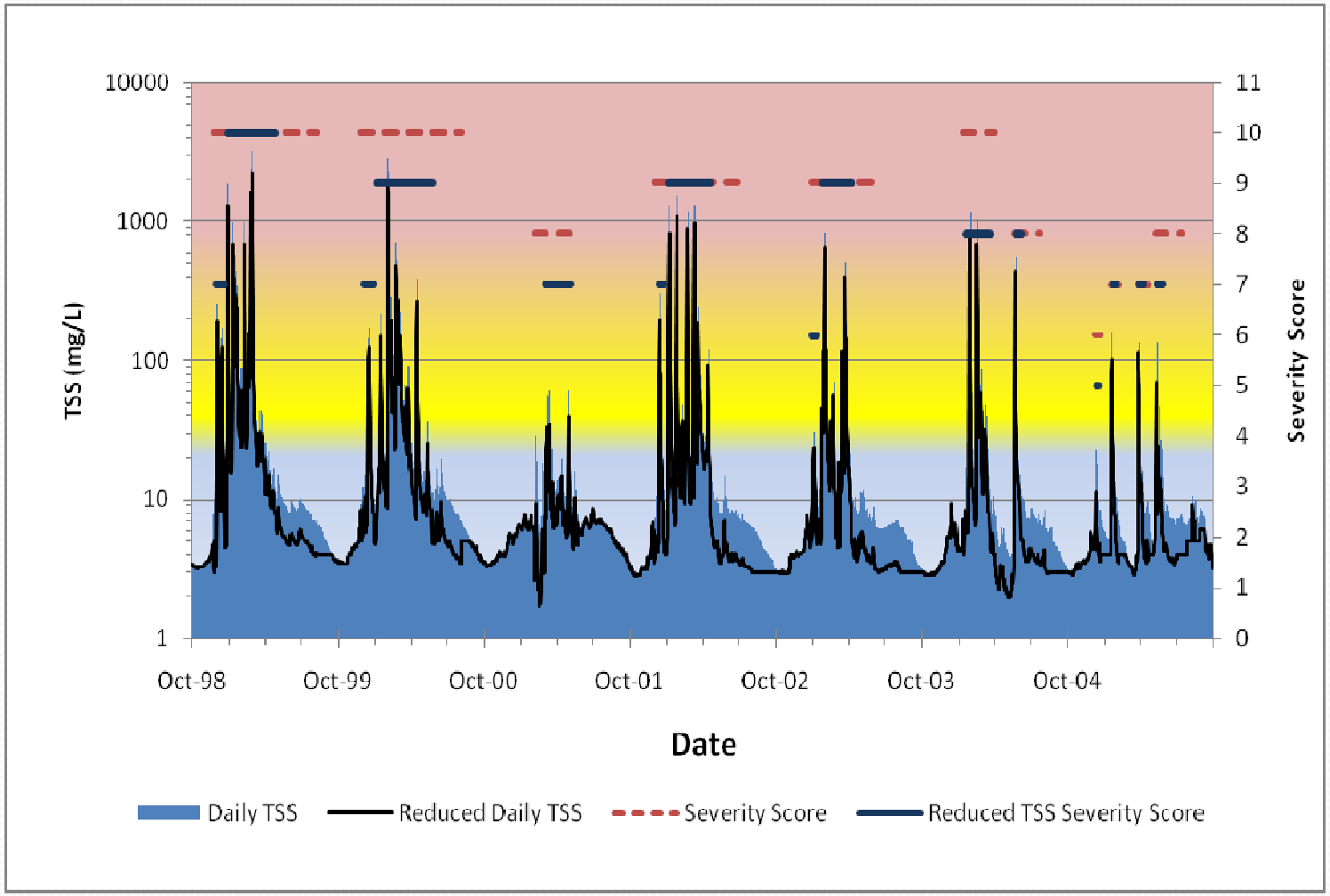
Site	Overall Reduction	Primary Sources	Reduction to Sources
Hangman Creek at Bradshaw Road	19%	Conventional Agriculture	56%
		Streambanks	74%
		Rangelands	31%
Little Hangman Creek	15%	Conventional Agriculture	55%
Rattler Run Creek	15%	Conventional Agriculture	54%
Rock Creek at Jackson Road	17%	Conventional Agriculture	55%
		Rangelands	18%
		Streambanks	90%


Suspended Sediment (tons)
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
0
50
100
150
200
250
300
350
Annual Average Discharge (cfs)
USGS ___
y = 0.0144x^2.8209
R² = 0.9807
Current Condition Model -----
y = 0.0065x^2.989
R² = 0.9122
Full Protection.....
y = 0.0035x^3.0475
R² = 0.9176
USGS
Current Condition Model
Full Protection

Turbidity and Suspended Sediment TMDL

Severity Scale	Description of Effect
No Effect	
0	No behavioral effects
Behavioral Effects	
1	Alarm reaction
2	Abandonment of cover
3	Avoidance response
Sub-lethal Effects	
4	Short-term reduction in feeding rates or feeding success
5	Minor physiological stress; increased coughing, increased respiration rate
6	Moderate physiological stress
7	Moderate habitat degradation; impaired homing
8	Indications of major physiological stress; long-term
Lethal and Paralethal Effects	
9	Reduced growth rate; delayed hatching; reduced fish density
10	0 – 20% mortality; increased predation; moderate to severe habitat degradation
11	>20 – 40% mortality
12	>40 – 60% mortality
13	>60 – 80% mortality
14	>80 – 100% mortality

Turbidity and Suspended Sediment TMDL



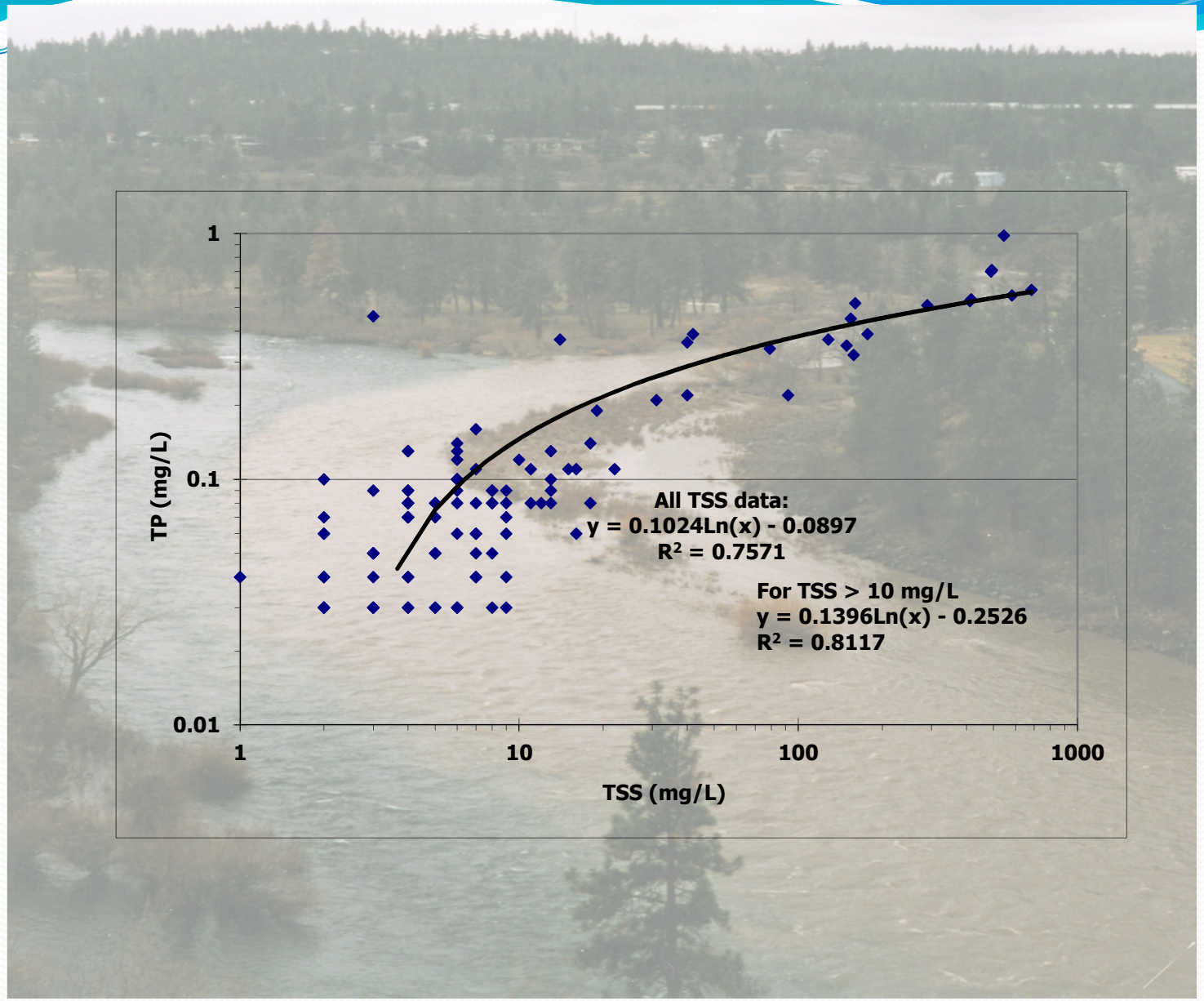
Hangman TMDL Recommendations

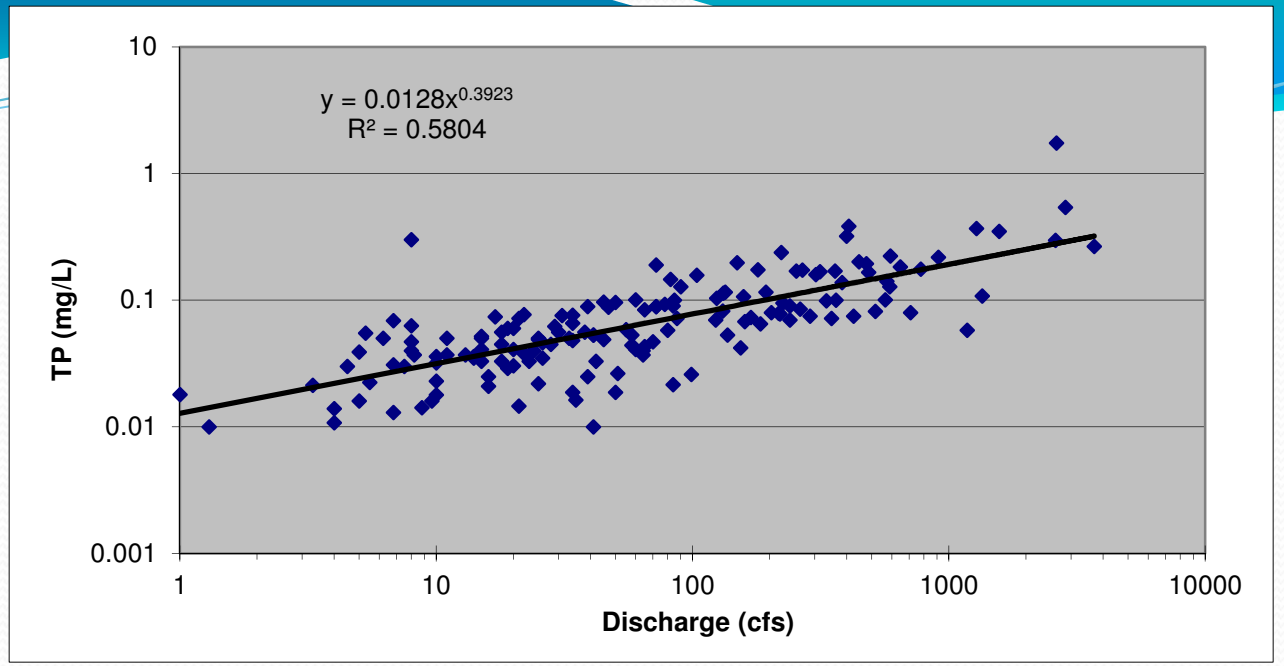
- Ecology will need to work with EPA, the Coeur d'Alene Tribe, and Idaho to reduce cross-border bacteria and TSS loads and to reduce instream temperatures in upper Hangman Creek, Little Hangman Creek, and Rock Creek.
- Most sites require more sampling to better identify sources of bacteria and seasonal patterns, especially where livestock, wildlife, and waterfowl sources are suspected.
- Direct livestock access to riparian areas should be limited to prevent fecal wastes and streambank sediment from directly or indirectly entering the waterways.
- Municipal Phase 2 Stormwater NPDES Permit, permit holders must map their stormwater systems, and determine if stormwater may be contributing bacteria, heated water, or TSS to surface water.
- Sources of fecal coliform and sediment from rural, suburban and urban areas should be addressed through best management practices (BMPs).

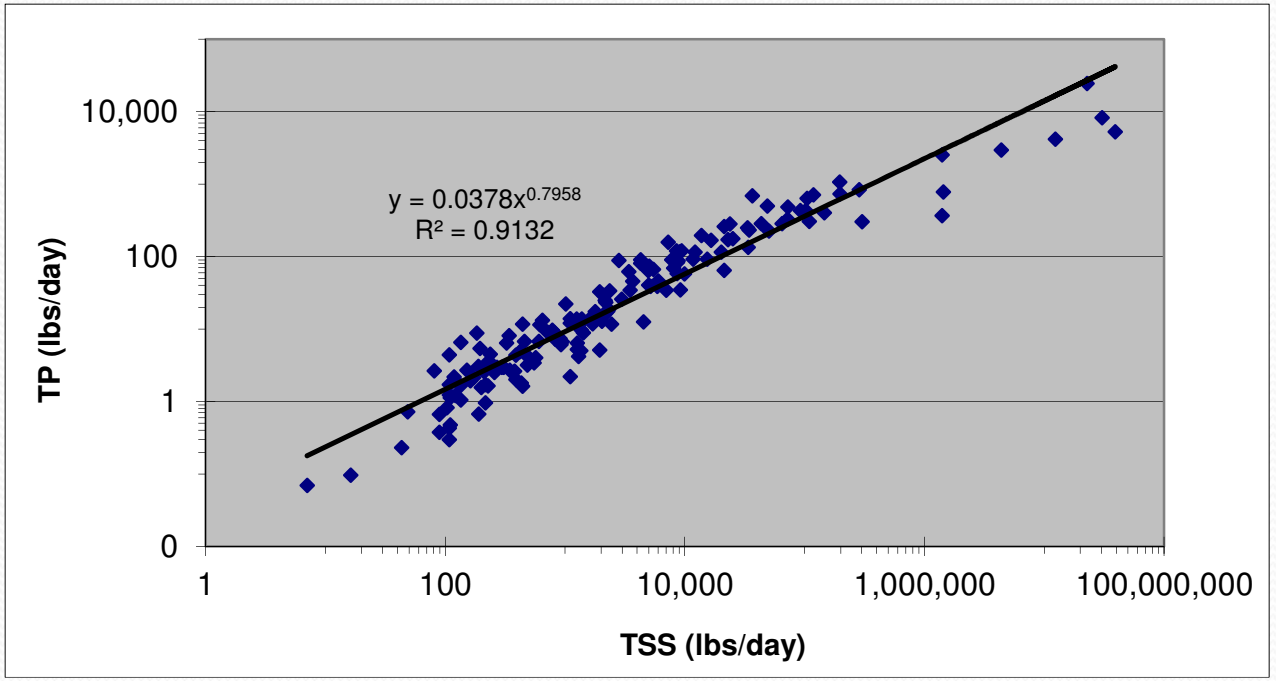
Hangman TMDL Recommendations

- Channel restoration measures, including the restoration of a functioning riparian area, should be implemented throughout the watershed to reduce erosion and heat loads on the stream.
- All WWTP facilities should monitor receiving water and effluent temperatures, and discharge volumes during spring through fall. These data will help us to understand thermal and dilution cycles so that compliance schedules and operational/facility options can be designed.
- Aquatic communities and suspended sediment loads should continue to be monitored to establish baselines and to measure success with erosion control and other improvements.
- Conversions of conventional agricultural practices to conservation practices is needed to meet the load allocations in this TMDL as this action will have the biggest impact in reducing TSS in the watershed.
- WARMF or a similar model should be supported with better local data for calibration and scenario-building.


What These TMDL Results
May Mean
for Total Phosphorus


1
0.1
0.01
TP (mg/L)
1
10
100
1000
TSS (mg/L)
All TSS data:
y = 0.1024Ln(x) - 0.0897
R² = 0.7571
For TSS > 10 mg/L
y = 0.1396Ln(x) - 0.2526
R² = 0.8117


y = 0.0128x^0.3923
R² = 0.5804
TP (mg/L)
10
1
0.1
0.01
0.001
1
10
100
1000
10000
Discharge (cfs)


y = 0.0378x^0.7958
R² = 0.9132
TP (lbs/day)
10,000
100
1
0
1
100
10,000
1,000,000
100,000,000
TSS (lbs/day)

EPA Level III Ecoregion Reference Nutrient Concentrations

Parameter	Northern Rockies Ecoregion 15		Columbia Basin Ecoregion 10	
	Number of Samples	25th percentile	Number of Samples	25th percentile
Total Phosphorus (mg/L)	150	0.0078	127	0.030
Nitrate + Nitrite Nitrogen (mg/L)	133	0.020	71	0.072

CURRENT CONDITIONS

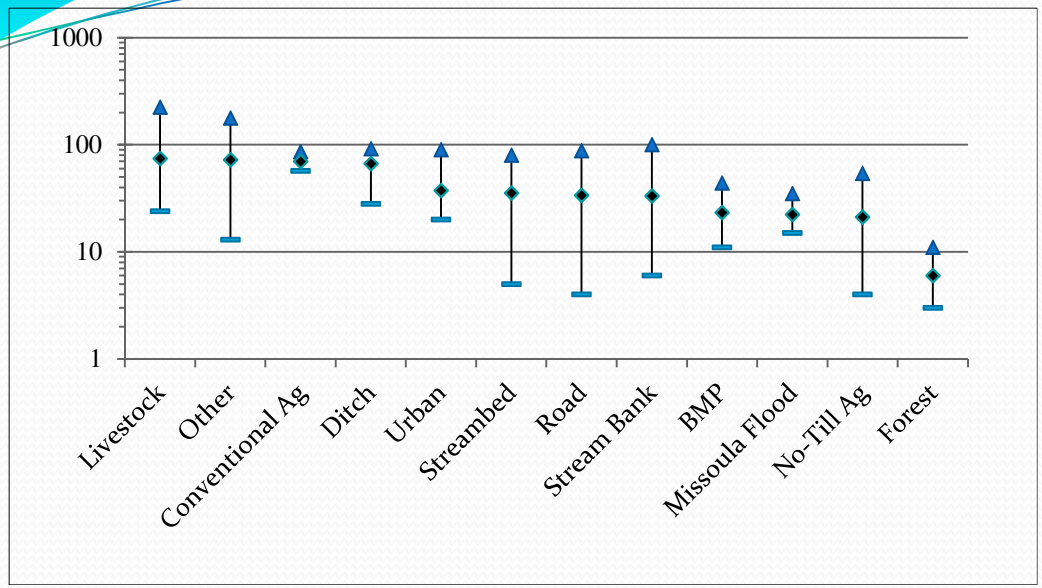
Year	April	May	June	July	August	September	October	April-May	June – October
1998	-	-	-	-	-	-	4.6	-	-
1999	138	47	19	10	6.6	5.4	6.5	92	9.5
2000	364	81	35	11	4.8	4.9	5.6	220	12
2001	98	71	8.3	4.2	1.4	0.7	1.6	84	3.2
2002	260	42	14	4.2	2.0	2.1	3.0	149	5.0
2003	92	37	8.0	1.7	0.9	1.4	1.6	64	2.7
2004	31	167	22	5.1	1.5	1.8	3.0	100	6.5
2005	72	115	13	3.7	0.4	0.4	-	94	-

FULL PROTECTION SCENARIO

Year	April	May	June	July	August	September	October	April - May	June – October
1998	-	-	-	-	-	-	1.5	-	-
1999	99	32	11	5.0	3.0	1.9	2.6	65	4.5
2000	284	55	20	5.7	1.8	2.0	2.0	169	5.5
2001	78	58	4.5	1.8	0.6	0.2	0.7	68	1.4
2002	210	34	6.6	1.9	1.0	0.8	0.8	120	2.1
2003	54	22	3.6	0.6	0.2	0.4	0.4	37	0.8
2004	20	137	13	2.1	0.6	0.6	1.0	78	2.8
2005	63	83	7.6	1.9	0.2	0.1	-	79	-
2001 Reduction	20%	19%	46%	56%	60%	67%	55%	20%	55%
Average Reduction	**25%**	**27%**	**46%**	**56%**	**61%**	**66%**	**65%**	**24%**	**58%**

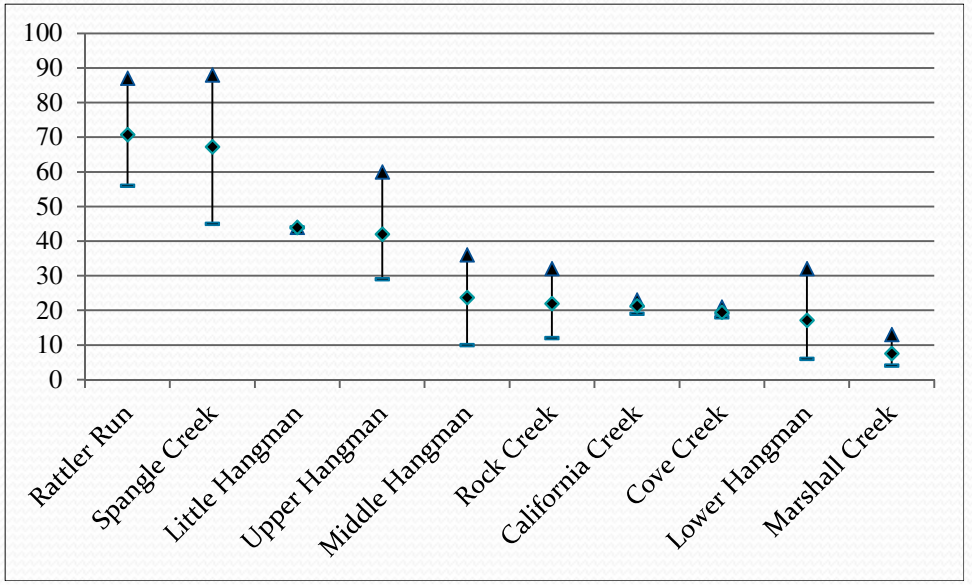
Hangman Phosphorus Loading Lessons

- Controlling streambank and upland erosion will significantly decrease phosphorus loading
- Hangman event-based loading will be difficult for monitoring load allocation compliance
  - Daily and seasonal TP load variability is high
  - Instream storage of phosphorus could be significant
  - Crop rotations and continued land use changes increase variability
  - Climate change effects could be significant for watershed hydrology



Plant-Available Phosphorus by Land Use Type

Streambank Plant-Available Phosphorus



Hangman Phosphorus Loading Lessons

- Background phosphorus concentrations are difficult to determine and model
  - Ecoregional soil concentrations
  - Legacy phosphorus may be an issue
  - Instream biological sequestering and release
- Point source impacts will be difficult to evaluate
  - April – May load insignificant compared to nonpoint
  - What are transport rates and fates of loads discharged at other times?

Hangman Dissolved Oxygen and pH TMDL Considerations

- Intermittent or pooled stream conditions
- Seasonal vs. Annual wasteload allocations to point sources
- Seasonal and Annual allocations to meet watershed capacity (low-flow) vs. Spokane River loading capacities (high-flow)
- Background condition scenario for loading capacity and load allocation determination
- Cross-border loading agreements

Implementation

Issues Identified by the Advisory Group:

- Agricultural runoff
- Improper function septic systems
- Livestock and wildlife
- Residential use of fertilizers and chemicals
- Sheer and undercut stream banks
- Lack of streamside vegetation
- Stormwater
- Summer, gravel roads and ditching
- Forestry management

Key Implementation activities:

- Conversion to direct seed tillage operation
- Other agricultural BMPs
- Riparian buffers/restoration
- Livestock fencing and off-stream watering

Implementation activities will also help dissolved oxygen, pH and nutrients

Keys to Implementation

- Permit limits will be incorporated into WWTP permits
- Develop *Implementation Plan* for nonpoint implementation
  - Who, what, when, funding
  - Have 1 year to complete after EPA approval of TMDL
  - Will be meeting with various entities and agencies to get implementation commitments
  - Seeking parties interested in helping with implementation planning
- Need community support and partners
- Need help with outreach and messaging
- Need funding sources and incentives, especially for agricultural efforts

What's Next?

- Draft TMDL report available April 20, 2009
  - Report: www.ecy.wa.gov/biblio/0910030.html
  - More info: www.ecy.wa.gov/programs/wq/tmdl/HangmanCr/index.html
- Public Comment Period April 20 – May 22, 2009
- Submit to EPA for approval
- Develop Implementation Plan which expands on strategy in TMDL report
- Continue study of dissolved oxygen, pH and nutrients in the watershed for future TMDL efforts